New suturing techniques to reconstruct the keystone area in extracorporeal septoplasty

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Abstract: BACKGROUND: Severe septal deformations require adequate treatment to restore shape and function using extracorporeal septoplasty. Because it has been criticized for being technically demanding to execute and has increased risk for aesthetic complications, the authors have developed two new suture techniques for refixation of the neoseptum. METHODS: A retrospective analysis of multisurgeon consecutive extracorporeal septoplasties performed from January of 2014 to December of 2014 was conducted at a single institution using the criss-cross or transcutaneous transosseous cerclage suture (group 1) compared with fixation at the upper lateral cartilages only (group 2). RESULTS: One hundred ten extracorporeal septoplasties were performed in 110 patients over 12 months. Group 1 consisted of 58 patients (53 percent), whether receiving the criss-cross [12 patients (21 percent)] or the transcutaneous transosseous cerclage suture [46 patients (79 percent)], and group 2 consisted of 52 patients (47 percent). The median follow-up was 11 months (range, 6 to 16 months). Operative revision because of complications at the dorsum or the keystone area had to be performed in no case in group 1 and in five cases (9.6 percent) in group 2, resulting in a statistically significant difference between the two groups ($p = 0.0212$). There were no complications such as bleeding or infection observed in any of the 110 cases. CONCLUSIONS: To facilitate and to reduce the complication rate after extracorporeal septoplasty, the authors have developed the criss-cross and transcutaneous transosseous cerclage suture to overcome the important and technically demanding reimplantation of the neoseptum. Thus, the authors believe that these new operative techniques are safe and reproducible procedures that may take a permanent place among extracorporeal septoplasty procedures. CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, III.

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New Suturing Techniques to Reconstruct the Keystone Area in Extracorporeal Septoplasty

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Background: Severe septal deformations require adequate treatment to restore shape and function using extracorporeal septoplasty. Because it has been criticized for being technically demanding to execute and has increased risk for aesthetic complications, the authors have developed two new suture techniques for refixation of the neoseptum.
Methods: A retrospective analysis of multisurgeon consecutive extracorporeal septoplasties performed from January of 2014 to December of 2014 was conducted at a single institution using the criss-cross or transcutaneous transosseous cerclage suture (group 1) compared with fixation at the upper lateral cartilages only (group 2).
Results: One hundred ten extracorporeal septoplasties were performed in 110 patients over 12 months. Group 1 consisted of 58 patients (53 percent), whether receiving the criss-cross [12 patients (21 percent)] or the transcutaneous transosseous cerclage suture [46 patients (79 percent)], and group 2 consisted of 52 patients (47 percent). The median follow-up was 11 months (range, 6 to 16 months). Operative revision because of complications at the dorsum or the keystone area had to be performed in no case in group 1 and in five cases (9.6 percent) in group 2, resulting in a statistically significant difference between the two groups ($p = 0.0212$). There were no complications such as bleeding or infection observed in any of the 110 cases.
Conclusions: To facilitate and to reduce the complication rate after extracorporeal septoplasty, the authors have developed the criss-cross and transcutaneous transosseous cerclage suture to overcome the important and technically demanding reimplantation of the neoseptum. Thus, the authors believe that these new operative techniques are safe and reproducible procedures that may take a permanent place among extracorporeal septoplasty procedures. (*Plast. Reconstr. Surg.* 138: 374, 2016.)
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Deviation of the septum effectively influences both function and shape of the nose. Consequently, severe septal deformations require adequate treatment to restore shape and function using the concept of extracorporeal septoplasty first described by King and Ashley.[1] Within the past three decades, the concept of extracorporeal septoplasty has been thoroughly revisited and refined.[2–5] Our current concept of extracorporeal septoplasty consists of en bloc removal of the bony-cartilaginous partition, extracorporeal creation of a straight and firm neoseptum (L-strut), and reimplantation by fixation to both the bony and cartilaginous framework.[5] The whole procedure is performed as part of a normal rhinoplasty using an open approach. In earlier studies, we reported about aesthetic complications in up to 11 percent of cases after extracorporeal septoplasty.[3] The critical and most important part in extracorporeal septoplasty is reimplantation of

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the neoseptum. This requires reattachment of both the cephalic dorsal neoseptum and the caudal part to the anterior nasal spine by using drill holes for fixation. Several surgeons still regard extracorporeal septoplasty as a procedure bearing unacceptable risk because of thorough skeletal destabilization. In detail, it has been criticized for being very technically demanding to execute and for bearing the increased risk for aesthetic complications, especially in the area of transition from the bony dorsum to the reconstructed cartilaginous dorsum (e.g., keystone area).[6] In this regard, using the open approach, we have developed new surgical techniques to reattach the cephalic dorsal neoseptum to the bony-cartilaginous transition zone to both simplify the technique and secure the stability of the fixation, reducing the risk for complications. In this study, we would like to introduce two different reattachment techniques: the so-called criss-cross suture and the transcutaneous transosseous cerclage suture. The sutures were used in extracorporeal septoplasty to reconstruct the keystone area and the postoperative course was recorded, including complications that occurred, compared with conventional techniques of reattachment.

PATIENTS AND METHODS

This study was approved by the appropriate institutional and/or national research ethics committee and performed including all procedures in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki according to existing German ethical standards. All participants gave their informed consent in writing before inclusion in the study, especially for publication of photographs.

A retrospective analysis of multisurgeon (two surgeons) consecutive extracorporeal septoplasties performed from January of 2014 to December of 2014 was conducted at a single institution. Patients' medical records and photographs were reviewed for complications such as aesthetic irregularities or contour deformities and dorsal saddling of the nose requiring operative revisions. All recorded patients were divided into two groups: group 1 included all patients undergoing one of the new suture techniques (criss-cross or transcutaneous transosseous cerclage suture, see below); in group 2, the reimplantation of the neoseptum was performed in the traditional way, where it was only fixed at the site of the upper lateral cartilages.

The extracorporeal septoplasty was always performed as follows. All operations were performed under total intravenous anaesthesia, and an open inverted-V approach was used. The septum was dissected submucoperichondrially. Then, the septum was released from the anterior nasal spine and the maxillary crest. The upper lateral cartilages were split from the septum. It was then dissected sharply from the bony vault. Further on, the septum was fractured in the bony part. In the caudal thin parts of the ethmoid bone, a vertical fracture line was performed with horizontal pressure with the tip of a 5-mm chisel. In the cranial thicker bony parts, the fracturing was performed with the Lindemann burr or articulated scissors. Then, the septum was taken out in one piece. Afterward, an L-shaped frame was created, and care was taken to design a round inner edge, which seems to be biomechanically more stable. Spreader grafts were sutured to the cranial edge of the neoseptum with a 4-0 polydioxanone suture with help of the Gubisch/Aiach clamp.

The caudal fixation of the neoseptum to the anterior nasal spine was always performed in the same way, creating a drill hole and using a 4-0 nonresorbable Prolene (Ethicon, Inc., Somerville, N.J.) suture for fixation by three passes. If necessary, a median groove was also drilled into the anterior nasal spine with a Lindemann burr for secure midline fixation. Spreader grafts were applied in 106 cases and spreader flaps were applied in four cases. Dorsal reduction was performed in 44 cases. The dorsal reduction was performed incrementally. The bony cap was removed with a 12-mm chisel and the bony edges were smoothened with a rasp or a power burr. Small bony humps were removed only with the rasp. All osteotomies were performed bilaterally and percutaneously, always including paramedian, low-to-low lateral, and transversal osteotomies. Demographics including patient age, sex, and traumatic injuries or prior operations of the nose were recorded.

Surgical Technique

Criss-Cross Suture

In cases, where the nasal bones were long enough, the criss-cross suture was performed (Fig. 1). (**See Video, Supplemental Digital Content 1**, which demonstrates a criss-cross suture. The graphic drawing illustrates the course of the suture. After pulling the skin envelope upward with an Aufricht retractor, a diagonal drill hole is marked and created through the caudal border of the nasal bone above the keystone area passing through both the upper lateral cartilages and the neoseptum in the center. Then, a 4-0 polydioxanone round needle suture is passed

Fig. 1. Detailed step-by-step demonstration of the criss-cross suture in a patient presenting with long nasal bones (*above*, *center*, and *below*, *left*). (*Below*, *right*) Graphic illustration of the suture course. (Drawing by Dirk Janku, M.D.)

through this drill hole, appearing on the contralateral side at the level of middle part of the left upper lateral cartilage. A second drill hole is created in the same way on the left nasal bone, again diagonally, passing through the upper lateral cartilages and the neoseptum. Then, the fixation suture is passed through the second drill hole from the left to the right side, appearing at the level of the right upper lateral cartilage and finally tied, creating a firm fixation in a criss-cross pattern, ***http://links.lww.com/PRS/B776***.) After initial correct positioning of the neoseptum, reimplantation can be started. After pulling the skin envelope upward by an Aufricht retractor, a diagonal drill hole is marked and created through the caudal border of the nasal bone above the keystone area, passing through both the upper lateral cartilages and the neoseptum in the center (Fig. 1, *above*). The, a 4-0 polydioxanone round needle suture is passed through this drill hole, appearing on the contralateral side at the level of middle part of the left upper lateral cartilage (Fig. 1, *center*, *left*). A second drill hole is created in the same way on the left nasal bone, again diagonally, passing through the upper lateral cartilages and the neoseptum (Fig. 1, *center*, *right*). Then, the fixation suture is passed through the second drill hole from the left to the right side, appearing at the level of the right upper lateral cartilage and finally tied, creating a firm fixation in a criss-cross pattern (Fig. 1, *below*, *left*). The graphic drawing illustrates the course of the suture in its final state after is tied (Fig. 1, *below*, *right*).

Video 1. Supplemental Digital Content 1 demonstrates a criss-cross suture. The graphic drawing illustrates the course of the suture. After pulling the skin envelope upward with an Aufricht retractor, a diagonal drill hole is marked and created through the caudal border of the nasal bone above the keystone area passing through both the upper lateral cartilages and the neoseptum in the center. Then, a 4-0 polydioxanone round needle suture is passed through this drill hole, appearing on the contralateral side at the level of middle part of the left upper lateral cartilage. A second drill hole is created in the same way on the left nasal bone, again diagonally, passing through the upper lateral cartilages and the neoseptum. Then, the fixation suture is passed through the second drill hole from the left to the right side, appearing at the level of the right upper lateral cartilage and finally tied, creating a firm fixation in a criss-cross pattern, ***http://links.lww.com/PRS/B776***.

Transcutaneous Transosseous Cerclage Suture

In cases, where the nasal bones are too short to create drill holes under direct view, the transcutaneous transosseous cerclage suture technique is used (Fig. 2). (**See Video, Supplemental Digital Content 2**, which demonstrates a transcutaneous transosseous cerclage suture: the power drill is mounted by a large-bore needle. The drill holes in the bone are created in a percutaneous fashion using the large-bore needle, which passes through the skin envelope, the nasal bones, the upper lateral cartilages, and the upper anterior border of the positioned neoseptum. The needle is disconnected from the drill and left in position. Then, a 4-0 polydioxanone suture is fed through the needle tip until it emerges from the needle hub. Hereafter, the needle is removed and the suture is left in position. A small hook is used to retrieve the suture ends subcutaneously after pulling up the skin flap. Then, the suture can be tied firmly over the bony dorsum to stabilize the reimplanted neoseptum, ***http://links.lww.com/PRS/B777***.) The power drill is mounted by a large-bore needle (Fig. 2, *above*, *left*). The drill holes in the bone are created in a percutaneous fashion using the large-bore needle, which passes through the skin envelope, the nasal bones, the upper lateral cartilages, and the upper anterior border of the positioned neoseptum (Fig. 2, *above*, *right*). The needle is disconnected from the drill and left in position. Then, a 4-0 polydioxanone suture is fed through the needle tip until it emerges from the needle hub (Fig. 2, *center*, *left*). Hereafter, the needle is removed and the suture is left in position. A small hook is used to retrieve the suture ends subcutaneously after pulling up the skin flap. Then, the suture can be tied firmly over the bony dorsum to stabilize the reimplanted neoseptum (Fig. 2, *center*, *right* and *below*, *left*). Figure 2, *below*, *right* demonstrates the course of the suture after drilling the holes by the cannula penetrating all layers at the keystone area.

Statistical Analysis

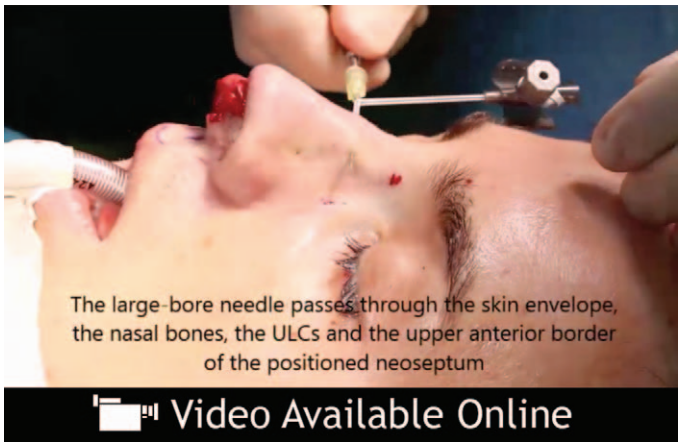
Univariate statistical analyses included Fisher's exact test for categorical variables. All tests were two-sided, and a value of $p \leq 0.05$ was used to

Fig. 2. Detailed step-by-step demonstration of the transcutaneous transosseous cerclage suture in a patient presenting with short nasal bones (*above*, *center*, and *below*, *left*). (*Below*, *right*) Graphic illustration of the layers perforated by the cannula and suture. (Drawing by Dirk Janku, M.D.)

determine statistical significance. Statistical analysis was performed using GraphPad Prism (GraphPad Software, Inc., La Jolla, Calif.).

RESULTS

Over the period of 12 months, 110 extracorporeal septoplasties were performed in 110 patients, including 67 male patients and 43 female patients. The median age of the patients was 37 years (range, 14 to 64 years). Group 1 consisted of 58 patients (53 percent) receiving the criss-cross suture [12 patients (21 percent)] or the transcutaneous transosseous cerclage suture [46 patients (79 percent)] for fixation of the reimplanted neoseptum at the keystone area (Fig. 3). In group 2, the neoseptum was fixed at the upper lateral cartilages only, and was performed in 52 patients (47 percent). The median follow-up was 11 months (range, 6 to 16 months). Operative revision had to be performed in one case (1.7 percent) in group 1 and in five cases (9.6 percent) in group 2, resulting in no significant difference between both groups ($p = 0.0988$). However, the single operative revision in group 1 after transcutaneous transosseous cerclage suture was performed because of a secondary thinning of a thick ala of the nose in a cleft patient and not for instability reasons or other complications at the keystone area. Considering revisions performed only because of complications at the keystone area (zero in group 1 versus five in group 2), there was a statistically



Video 2. Supplemental Digital Content 2 demonstrates a transcutaneous transosseous cerclage suture: the power drill is mounted by a large-bore needle. The drill holes in the bone are created in a percutaneous fashion using the large-bore needle, which passes through the skin envelope, the nasal bones, the upper lateral cartilages, and the upper anterior border of the positioned neoseptum. The needle is disconnected from the drill and left in position. Then, a 4-0 polydioxanone suture is fed through the needle tip until it emerges from the needle hub. Hereafter, the needle is removed and the suture is left in position. A small hook is used to retrieve the suture ends subcutaneously after pulling up the skin flap. Then, the suture can be tied firmly over the bony dorsum to stabilize the reimplanted neoseptum, ***http://links.lww.com/PRS/B777***.

significant difference between the two groups (p = 0.0212). In contrast, the revisions in group 2 were performed because of secondary saddling and dorsal irregularities of the nose (Fig. 4). There were no complications such as bleeding or infections observed in any of the 110 cases. In 100 of 110 cases (91 percent; 51 cases in group 1 and 49 cases in group 2), bilateral percutaneous osteotomies (paramedian, low-to-low lateral, and transverse) were performed. Seventy-five of 110 cases were primary (41 cases in group 1 and 34 cases in group 2) and 35 of 110 (15 cases in group 1 and 20 cases in group 2) were secondary rhinoplasties. In addition to the 35 revision rhinoplasties, 14 extracorporeal septoplasties were performed in posttraumatic (seven cases in group 1 and seven cases in group 2) septal deformities and 61 extracorporeal septoplasties were performed in congenital (15 cases in group 1 and 20 cases in group 2) septal deformities.

DISCUSSION

This study demonstrates that effective and firm reimplantation of the neoseptum for reconstruction of the keystone area after extracorporeal septoplasty is mandatory. Introducing these two new operative techniques, the criss-cross and transcutaneous transosseous cerclage suture, the revision rate after extracorporeal septoplasty caused by instability resulting in saddling and dorsal irregularities resulting in aesthetic complaints could be effectively reduced.

Septal deviations represent a major cause of both aesthetic disorders and respiratory obstruction. However, in severe or unfavorably localized septal deviations, traditional septoplasty techniques may often be inadequate and limited to correct the existing problem.[7] For a long time, extracorporeal septoplasty has been regarded as a technically demanding operative procedure bearing an unacceptable risk because of skeletal destabilization. However, a recent study performed by Lee and Yang has compared treatment outcomes of extracorporeal septoplasty with those of in situ septal correction in rhinoplasty.[8] They were able to demonstrate that extracorporeal septoplasty can achieve comparable aesthetic results but even better functional outcome than in situ septal correction in rhinoplasty.[8] Also, Wilson and Mobley showed data indicating that complication rates of extracorporeal septoplasty are similar to those of endonasal septoplasty.[9] Thus, extracorporeal

Fig. 3. This 30-year-old patient underwent an extracorporeal septoplasty procedure during an open rhinoplasty. He presented with severe posttraumatic deviation both of the septum and of the nose, with a bony-cartilaginous hump demonstrated on frontal (*above*, *left*) and side (*above*, *right*) views. Reimplantation of the neoseptum during extracorporeal septoplasty was performed by a transcutaneous transosseous cerclage suture. Postoperative photographs 6 months after surgery show a very nice result, with a straight nose and aesthetic dorsal lines showing no saddling or other irregularities at the dorsum (*below*).

septoplasty does not bear an increased risk for aesthetic complications and seems to be a safe procedure. In our study, we also did not observe any differences in aesthetic outcomes or complication rates after extracorporeal septoplasty compared to in situ septal correction procedures (data not shown). To facilitate the technically demanding operative step of reimplantation of the neoseptum, we developed two techniques: the criss-cross suture and the transcutaneous transosseous cerclage

Fig. 4. This 45-year-old patient underwent an extracorporeal septoplasty procedure during an open rhinoplasty. She suffered from severe posttraumatic nasal obstruction and massive septal and nasal deviation on the preoperative frontal (*above*, *left*) and side (*above*, *right*) views. During extracorporeal septoplasty, reimplantation of the neoseptum was performed by the traditional fixation at the upper lateral cartilages only. Spreader grafts and temporal fascia for dorsal refinement were used. Postoperative photographs 6 months after surgery showed a saddling of the nose with an inverted-T deformity (*below*), which indicated a revision procedure.

suture. Both techniques aim at stable refixation of the neoseptum at the bony-cartilaginous transition zone, the keystone area. Because evaluation of photographs for aesthetic or dorsal irregularities is based mainly on subjective view, we only evaluated complications that inevitably needed surgical revision to increase informative value. Performing these techniques in 58 patients over a period of 12 months, we did not observe any complications needing operative revision that were associated

with instability or minor aesthetic outcome after extracorporeal septoplasty. However, one revision was performed to thin out a thick ala of the nose in a cleft nose patient. In contrast, the traditional technique of reimplantation of the neoseptum (refixation at the upper lateral cartilages) was associated with five operative revisions because of irregularities, saddling, or poor aesthetic outcome at the nasal dorsum. In all cases, we observed a septal dislocation presenting with dorsal saddling combined with irregularities in four and a sidewall flattening in one case. Consequently, we believe that both the transcutaneous transosseous cerclage and criss-cross suture may represent effective operative techniques for reconstructing the keystone area after extracorporeal septoplasty. However, because the criss-cross suture was performed in only 12 patients in this study, validated conclusion on that technique is limited.

In 32 of the cases, additional allogenic fascia grafts (Tutoplast Fascia Lata; Tutogen Medical, Alachua, Fla.) were applied, and in 13 cases (eight cases in group 1 and five cases in group 2), diced cartilage wrapped in fascia was applied as a contour graft to restore dorsal height. Because additional fascia or diced cartilage wrapped in fascia may camouflage the impact of septal dislocation on the profile line, this might be a further limitation of the study. However, according to our experience, we believe that displacement of the neoseptum will also lead to collapse of the cartilaginous vault, resulting in an inverted-V deformity affecting the side walls that cannot be concealed with dorsal grafts. Furthermore, the distribution of cases with fascia grafts only (18 cases in group 1 and 15 cases in group 2) and diced cartilage wrapped in fascia grafts (eight cases in group 1 and five cases in group 2) was very homogenous, thus decreasing the risk for bias.

The indication for each operative technique can further be distinguished: the criss-cross suture can easily be performed in noses where the nasal bones are long enough to refix the neoseptum. However, because the transcutaneous transosseous cerclage suture is performed in a percutaneous fashion, it can be performed in all extracorporeal septoplasties, especially if the nasal bones are too short and cannot be adequately revealed to perform the criss-cross suture. Furthermore, the transcutaneous transosseous cerclage suture seems to be easier to perform and does not require extended skin dissection.

CONCLUSIONS

Extracorporeal septoplasty still remains the gold standard in severe septal deviations. To facilitate and to reduce the complications rate after extracorporeal septoplasty, we have developed the criss-cross and transcutaneous transosseous cerclage suture to overcome the important and technically demanding reimplantation of the neoseptum. Thus, we believe that these new operative techniques are safe and reproducible procedures that may have a permanent place among extracorporeal septoplasty procedures.

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PATIENT CONSENT

Patients provided written consent for the use of their images.

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